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This article explores how media coverage of a price war affects customer, retailer, and investor reactions over time. Using data covering a Dutch supermarket price war (2003–2005), the authors find that price reductions, especially deep reductions, trigger media coverage of the price conflict. This sets off a chain of reactions. Press messages have a significant effect on market share and abnormal stock returns, beyond retailers' own price and advertising. Importantly, this study uncovers striking asymmetries regarding the kind of coverage to which stakeholders react: whereas consumers only respond to the tone of price-related press coverage, retailers and investors only react to its quantity. Next, media coverage feeds back into the retailers' pricing actions: more media coverage triggers new price cuts in addition to those dictated by competitive reactions. As such, media coverage triggers a deeper spiral of price cuts, intensifying the competitive price battle. However, as the price war progresses, media coverage becomes less frequent and less favorable, which decelerates the downward price spiral.

Keywords: media coverage, price war, retailing, hierarchical Bayes, time series econometrics

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Fanning the Flames? How Media Coverage of a Price War Affects Retailers, Consumers, and Investors

> The news coverage of conflict, including the reporting about war, is often grounded in the notion that conflict has news value. As a result, war reporting is often sensational and sexy.
>
> —Lee and Maslog (2005, p. 311)

Conflicts are omnipresent in business and marketing. These conflicts are covered extensively in the independent press ("media" hereinafter). Examples include news media reporting on conflicts relating to product standards (Augerau, Greenstein, and Rysman 2006), copycatting (Van Horen and Pieters 2012), advertising wars (Stabile 2000), and price wars (Baltesen 2006). Because media coverage can drive public opinion (Gamson and Modigliani 1989) and investor behavior (e.g., Engelberg and Parsons 2011; Fang and Peress 2009; Tetlock 2007; Tetlock, Saar-Tsechansky, and Macskassy 2008), it is crucial to understand the role of the media in a conflict between businesses competing for customers and investors. In particular, a pressing issue is whether media reporting on the conflict has an effect beyond the firms' own marketing activities and, if so, how this effect unfolds for different stakeholders over time. Though this issue is essential to understand the competitive landscape, the business literature has not yet addressed it. Little attention has been paid to how media in conflict settings shape companies' marketing actions or channel (and

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possibly exacerbate) the impact of these actions on the firms' core audiences: customers and investors. The purpose of this research is to address this gap, and we do so in the context of a price war.

Price wars are a form of extreme price competition in which firms offer deep price cuts to undercut competitors (Heil and Helsen 2001). These cuts in regular prices are permanent and, as such, are very different from temporary promotional price discounts. A price war is a type of conflict between businesses that is particularly intense and can even lead to firm bankruptcy (Busse 2002; Van Heerde, Gijsbrechts, and Pauwels 2008). Price wars typically attract extensive media coverage (e.g., Wood 2011). Still, none of the dozens of price war articles (Heil and Helsen 2001) have considered media as a trigger or contributor; instead they have focused on competitive entry (Elzinga and Mills 1999), declining economic conditions (Slade 1990), consumers' eroding brand loyalty and increasing price sensitivity (Klemperer 1989), firm strategies to signal toughness to competitors (Besanko, Dranove, and Shanley 2000) or a favorable price image to customers (Rao, Bergen, and Davis 2000), high stakes in the market, or a worsened financial situation (Busse 2002).

Although these factors indeed matter, recent cases point to the potentially important role of media coverage (Van Aalst et al. 2005). For example, in the context of the 2003–2005 Dutch supermarket price war (e.g., Van Heerde, Gijsbrechts, and Pauwels 2008), commentators have suggested that it is actually the terminology adopted by the press (e.g., "slap in the face," "death blow") that turned competitive conduct into warfare (Jongen 2005). Though anecdotal, this example suggests that media coverage may play a part of its own in the ignition and development of a price war and raises some critical issues: How do the media react to strong reductions in regular price, and how does this coverage affect the different stakeholders over time? Does the amount and tone of media coverage trigger extra responses from the firms' target audiences of consumers and investors, beyond those directly induced by the firms' price cuts? If so, what is the direction of these effects, and do they play out in the same way for different audiences? Conversely, does media coverage trigger additional price cuts on the part of the firms, thereby further stimulating the price war spiral (adding fuel to the fire, so to speak)? These are the questions that our research explores.

We analyze the role of the media in a large-scale price war among Dutch grocery retailers in the period 2003–2005. Importantly, this price war involved major cuts in regular price for thousands of stockkeeping units (SKUs), which is a vastly different setting from the typical promotional discounts studied in the price promotion literature. We study the players involved in the price war: the retailers, the consumers who purchase at these retailers, the investors who buy shares of these retailers, and the media sources that report on the price war. Using a unique weekly data set (2002–2007), we analyze how the volume and valence of price-related press articles influence retail prices, market share, and abnormal investor returns (i.e., changes in stock price corrected for the risk-free return; e.g., Srinivasan et al. 2009). We distinguish between single-chain messages (reports on only one retail chain) and multichain messages (reports on multiple retail chains). By including media variables, we separate the direct effect of firms' marketing actions on their customers, investors, and competitors from the extra, indirect effect channeled through the media.

We find that media coverage plays a crucial role in a price-war setting. First, unlike single-chain messages, multichain messages drive retailer, consumer, and investor reactions beyond the price cuts per se. Whereas the valence of these messages significantly affects the retailers' market shares, the number of messages affects retailer pricing decisions and abnormal stock returns. Finally, media coverage initially triggers a deeper spiral of price cuts (adding fuel to the fire) but then slows down this spiral as the coverage becomes less frequent and less positive.

CONCEPTUAL FRAMEWORK

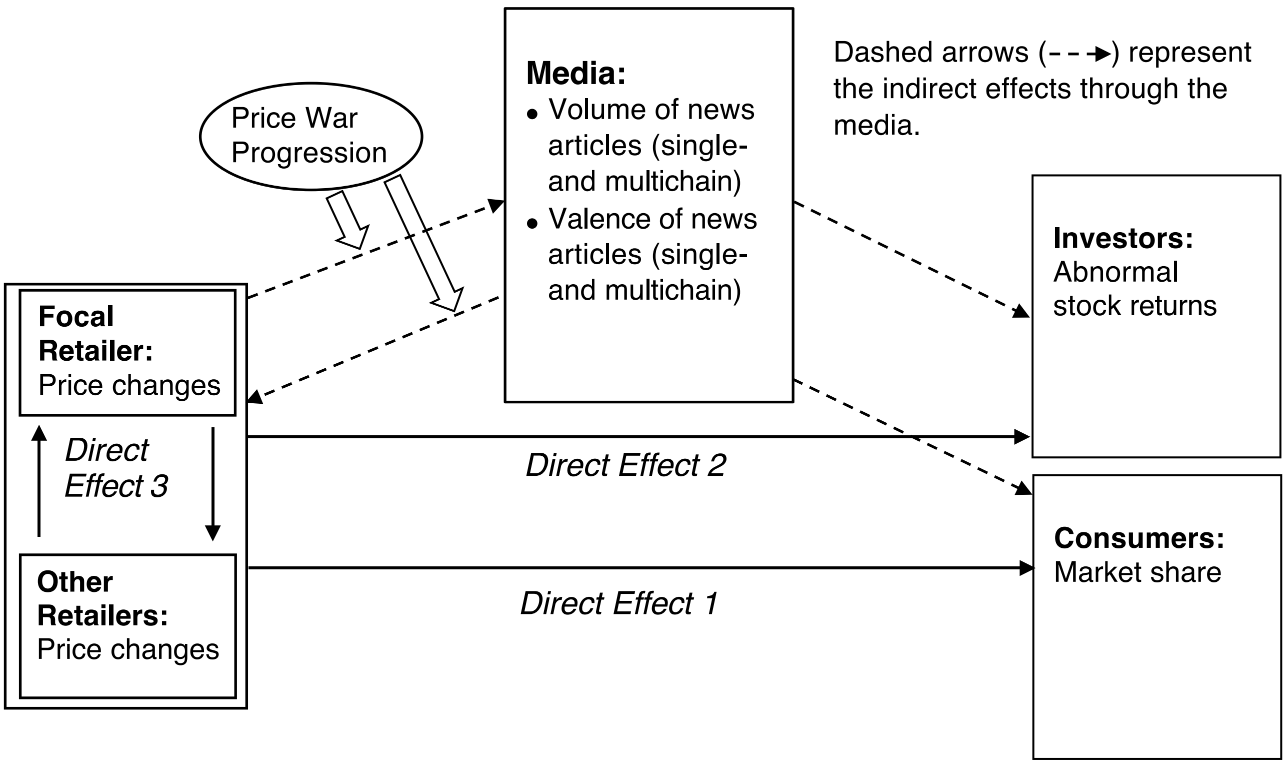
Traditionally, marketing response analyses have examined how firms' marketing actions such as price changes and advertising affect demand. More recent studies have begun to broaden the set of stakeholders to investors, investigating how marketing activities drive stock returns (e.g., Srinivasan and Hanssens 2009). We expand this framework of firms, consumers, and investors by also considering the media. Media outlets are likely to report on the firms' actions, especially in a conflict setting. Even though the firms' marketing activities are, in principle, observable by consumers and investors, media coverage of these actions may channel part of their effects. Indeed, media coverage may be perceived as more accessible, credible, and important information than firm communications (Xiong and Bharadwaj 2013). As such, we conjecture that in a price war setting, media coverage of firms' pricing actions may influence consumers and investors beyond the direct effect of such actions. Next, we develop a framework on the antecedents and consequences of media coverage of firms' price cuts in a price war. Although most of the discussion applies to firms in general, we occasionally limit it to retailers when relevant.

Figure 1 presents the conceptual framework. We first review the literature on the interplay between the traditional stakeholders (i.e., firms, consumers, and investors) in the context of regular (non–price war) competition. Next, we discuss what happens when a price war erupts, paying special attention to the role of the media in such a setting.

Price Changes and Consumer, Shareholder, and Competitor Response

In line with the argument that studying competitive reactions requires examining changes rather than levels (Leeflang and Wittink 1992, 1996, 2001), we use price changes as the pricing construct. For consumers, price changes have been shown to be an important driver of store choice, basket size, and market share (e.g., Fox, Montgomery, and Lodish 2004), reflected in Direct Effect 1 in Figure 1. Studies on shareholders' reactions to price changes (Figure 1, Direct Effect 2) suggest that these reactions are less clear cut. On the one hand, price reductions may signal to investors that the firm is going to do well with consumers, and this anticipation may boost stock returns (Joshi and Hanssens 2010). The retailer may become more attractive to shoppers and, from a financial perspective, make up for lower prices with higher demand and/or wholesale price concessions from manufacturers (Van Aalst et al. 2005). On the other hand,

Figure 1
ROLE OF MEDIA IN A PRICE WAR



price cuts erode profit margins, which may drive down investors' firm valuation (Srinivasan and Hanssens 2009).

The strength of competitive reactions (Figure 1, Direct Effect 3) depends on the intensity of the attack, the strategic versus tactical nature of the action, and the implementation requirements, (i.e., the time and effort needed to react; Steenkamp et al. 2005). Retailer price reactions, in particular, have been found to be quite pervasive and quick (Leeflang and Wittink 1992). This follows from the finding that "retailers can manipulate these variables easily without manufacturer input" (Leeflang and Wittink 1992, p. 46). Retailer reactions are based on beliefs about the harm that would be inflicted without these reactions: if consumers are alert to price cuts, not dropping prices may drive consumers to the competition (Leeflang and Wittink 2001). Moreover, managers (retailers) tend to have competitive-oriented objectives, know more about competitors' actions than about consumer responses, and overestimate the extent to which consumers compare alternatives (Leeflang and Wittink 1996). This may explain why, even in a business-as-usual setting, retailers have been found to follow competitors' price cuts, often in the same week or the week after (Leeflang and Wittink 1992).

What Is Different in a Price War?

A price war requires one or more of the following conditions (Heil and Helsen 2001): (1) a strong focus on competitors instead of on consumers, (2) that the pricing interaction as a whole is undesirable to firms, (3) that the competitors neither intended nor expected to ignite a price war, (4) that the competitive interaction violates industry norms, (5) that the pricing interaction occurs at much faster rate than normal, (6) that the direction of pricing is downward, and (7) that the pricing interplay is not sustainable. Thus, price war settings are characterized by unusually deep cuts in regular prices that are meant to improve the firm's position relative to competitors.

We argue that price wars affect the interactions between retailers, consumers, and investors in two important ways. First, the reductions in regular price are unusually deep, which is likely to trigger additional responses beyond the "business-as-usual" (non–price war) price changes. Because of the multitude of items sold at a given grocery chain, consumers and investors may not be perfectly informed about, or able to monitor, products' actual prices or price changes (Mägi and Julander 2005). As such, they may be more responsive to price changes that exceed a threshold of "just noticeable differences" (Nijs, Srinivasan, and Pauwels 2007). This is why, in the context of a price war, we need to distinguish between the effects of "business-as-usual" changes in regular price (increases or decreases) on consumers and investors and those that are unusually deep regular-price reductions (large price decreases). Hereinafter, to avoid repetition, we use the term "price changes" to reflect changes in regular price and "deep price reductions" to reflect deep reductions in regular price.

Second, these unusually deep price reductions are newsworthy, which means that the media are likely to report on them. As such, the media may begin channeling some of the interactions between retailers, consumers, and investors. Firms that attack each other by offering unusually deep price cuts are likely to attract media attention. When the media report the price changes offered in a price war, this coverage begins to become a second source of price information for retailers, consumers, and investors beyond actual, objective prices to gauge the store's expensiveness (Hamilton and Chernev 2013). By covering the firm's pricing actions, the media can further affect consumers' and shareholders' behavior and trigger new price reactions among rival retailers. We discuss these links (dashed arrows in Figure 1) in more detail next.

Impact of Price Changes on Media Coverage

Research in communication and public relations has long examined reporting by media professionals. The conceptual foundation of these studies is gatekeeper theory (Lewin 1947): as gatekeepers, journalists and editors determine *what* is talked about (agenda setting) and tell the public *how* to think about the topic (framing) (e.g., Barzilai-Nahon 2008). For independent media to cover an event, it must be newsworthy—that is, it must (1) be unusual and threaten the status quo ("deviance") and (2) cater to the interests of the audience ("social significance") (Shoemaker, Danielian, and Brendlinger 1991). Price cuts in the context of a price war meet both criteria. First, these price cuts are typically unusually large—thus violating industry norms and stirring up the competitive interplay (Heil and Helsen 2001). Second, news readers include consumers and investors—two groups that have personal interests in substantial (and enduring) price cuts by major retailers (Shoemaker, Danielian, and Brendlinger 1991). As such, we expect the price cuts offered in a price war, and the competitive conflict inherent in such actions, to be newsworthy and generate a large *volume* of media messages. Thus, the larger the price reduction, the more news messages, especially if the price is reduced by an unusual amount.

A second question relates to how the media frame these price reductions in their messages (i.e., the message valence). Positive-valence messages publicize the firm's price cuts or emphasize its low-price position, whereas negative-valence messages report that the retailer has not yet followed suit on competitors' price reductions or that it remains expensive. Lower prices represent good news in the form of savings to many consumers subscribed to newspapers. Moreover, the media may even have an interest in keeping the price war going because conflict is news, and news sells (Allen and Seaton 1999). Therefore, rather than condemning the price war, they may heap praise on the chains that cut prices, especially at the beginning of the price war. Thus, we expect that price reductions, and especially deep ones, will enhance the valence of media coverage, particularly at the start of the price war.

Impact of Media Coverage on Retailer Prices

Media coverage of a price war is likely to feed back into retailer prices. Retailers are also news consumers who pay attention to media price reporting concerning their own firm. An increase in the *number* of price-related messages may make price more salient to consumers (Van Heerde, Gijsbrechts, and Pauwels 2008). For fear of harmful consequences if they do not take action (Leeflang and Wittink 1992), retailers may be pressured to pursue a favorable price position even more strongly. This is especially likely in a setting with considerable "competitive noise" (Axelrod 1997) because price wars are facilitated by companies that are uncertain about the effects of their marketing actions (Heil and Helsen 2001). In such settings, price war reporting by the media may fuel further price cutting.

The message *valence* will also matter to retailers when considering cutting prices. Similar to the notion of a firm exploiting synergies between price cuts and its own advertising (Pauwels 2004), the retailer may believe that positive media attention renders further price cuts even more effective and will subsequently ramp up its price reductions.

Decay Effects

Although we expect media coverage to reinforce the downward spiral in prices typical of a price war, there is reason to believe that this spiral will eventually die down. For example, especially at the beginning of the price war, the competitive conflict inherent in such price actions is newsworthy and can be expected to boost the performance of the media outlet (Allen and Seaton 1999). However, as the price war unfolds, its news value erodes, and the amount of media coverage may follow suit. The message framing also may evolve. The tone of the messages may become less positive because the initial enthusiasm about the price cuts may wear out. As such, we expect media to cover the price changes less extensively and less favorably as the price war progresses.

As the price war evolves, retailers may become less likely to meet media messages with new price cuts because these messages no longer catch them by surprise and their already-reduced margins may render further price cuts prohibitive. Moreover, to the extent that their attained price position has already become more favorable or the negative side effects of the price-cutting spiral have become more apparent in the marketplace, (positive) media messages that publicize their price cuts or low overall prices are less of an incentive for further price reductions. Thus, as Figure 1 shows, we expect the spiral of price reductions that leads to more (positive) media reporting—and, in turn, to further price reductions—to die down as the price war progresses.

Impact of Media Coverage on Consumers

How will consumers respond to media coverage on price changes? We posit that media messages may have an effect of their own, beyond the influence of actual price changes (Wärneryd 1986). Independent media have an aura of objectivity: whereas consumers may disregard price-cut announcements by firms themselves because of their persuasive motives (Kelley 1973), media messages are not spurred from the intention to sell and are likely to be considered more truthful. Thus, positive messages in the media that publicize a retailer's price reductions or underscore its low prices may make consumers more likely to purchase at that retailer, even after controlling for actual price changes.[1]

[1]Because most of the price cuts apply to established manufacturer brands, the selection of which differs among retailers, we do not expect them to affect the perceived quality of those brands. Still, to make up for the lowered margins, retailers may reduce their assortments or economize on service and may do so more strongly as the price war progresses and financial pressure intensifies.

Moreover, the extant literature has suggested that such market share increases need not be confined to positive messages and that, indeed, "any publicity is good publicity" (Berger, Sorenson, and Rasmussen 2010, p. 815). This may follow from two mechanisms: (1) an awareness effect, in which media coverage makes the retailer more top of mind in the consumer's set of shopping alternatives, and (2) a fading-out effect, in which the (possibly negative) valence of the message becomes dissociated from the message itself by the time the consumer actually engages in shopping (Berger, Sorenson, and Rasmussen 2010). Thus, we postulate that the quantity of messages (irrespective of the valence) may also drive market share.

Impact of Media Coverage on Abnormal Stock Returns

We believe that investors will also respond to media coverage of the firms' pricing actions. Consider the *number* of messages first: on the one hand, more extensive coverage may trigger investors' attention to the firm (Xiong and Bharadwaj 2013) and may signal that it is a market player "to reckon with." On the other hand, media coverage in the realm of a price war carries a negative connotation. suggesting that the firm is involved in cutthroat competition, which may harm its future returns. Indeed, more often than not, research has shown price wars to be financially harmful (Heil and Helsen 2001; Rao, Bergen, and Davis 2000) and that prevention of price wars is the best cure (Garda and Marn 1993). Price cuts reduce unit margins, which will decrease the expected returns unless volume sales increase proportionately (Gordon 1959). Such strong sales increases are especially unlikely in price wars because fast competitive retaliation leaves firms struggling to gain market share (Heil and Helsen 2001; Van Heerde, Gijsbrechts, and Pauwels 2008). This may trigger negative investor reactions. For example, when Philip Morris announced a 20% price cut to its Marlboro cigarettes on April 2, 1993 ("Marlboro Friday"), its stock fell 26% (Sellers 1993). As such, extensive media coverage of the firm's involvement in a price war may be a bad omen for investors because it may reduce discounted future cash flows, which are reflected in stock returns. Thus, we expect a negative impact of the number of price war media messages on abnormal stock returns.

As for the *valence* of the messages, positive messages underscoring the firm's price cuts or favorable price position may reinforce the belief that it is going to maintain its foothold in the market. Consequently, we expect a positive effect of the valence of messages on abnormal stock returns.

Single- Versus Multichain Messages

We distinguish between multichain press messages covering several retailers and single-chain messages pertaining to only one retailer. The media effects we have discussed will hold especially for multichain press messages covering several retailers. First, we expect media to primarily cover the price war with multichain messages because much of the newsworthiness lies in the conflict between, and relative position of, the different players. Second, we expect such multichain messages to elicit stronger reactions. Because they compare different retail chains, multichain messages may be more informative and bring extra insights for the stakeholders. Single-chain messages may be induced by the firm's advertising and thus viewed as an extension of the firm's own communication. That is, a journalist can write a single-firm message directly based on a firm's advertising or press release after a fact check, which is rather straightforward in the case of price cuts. To write a multichain message, journalists must compare firms and thus are unlikely to repeat a directly controlled message. As such, consumers and shareholders are likely to view multichain messages as more objective sources of information. Thus, although we include both message types in the empirical analysis, we expect stronger effects for multichain messages.

Other Price War Effects

Prior research has documented an increase in consumer price sensitivity during a price war (Van Heerde, Gijsbrechts, and Pauwels 2008). Following an approach similar to Leeflang and Wittink's (2001), we allow for a direct effect of price on market share and for an indirect effect through the media. The mechanism is this: a price cut in itself will enhance market share (Direct Effect 1 in Figure 1). The deep price cuts offered during a price war may lead to extra (positive) press messages about the retailer, which, in turn, enhance retailer share beyond the direct impact of the price reduction. This would mean that the same price cut would elicit a stronger response in terms of market share if the path through the media is activated, corresponding to an increase in the total price sensitivity. In the "Robustness Checks" subsection, we verify whether this mechanism suffices or whether there is a need for an additional impact of the price war on price sensitivity.

Another potential effect is the decay in the effect of media coverage on market share and abnormal returns. That is, as the price war progresses, consumers and investors may be growing tired of the news coverage of the price war, leading to a weaker impact on their purchase and investment decisions. We also verify this possibility in a robustness check.

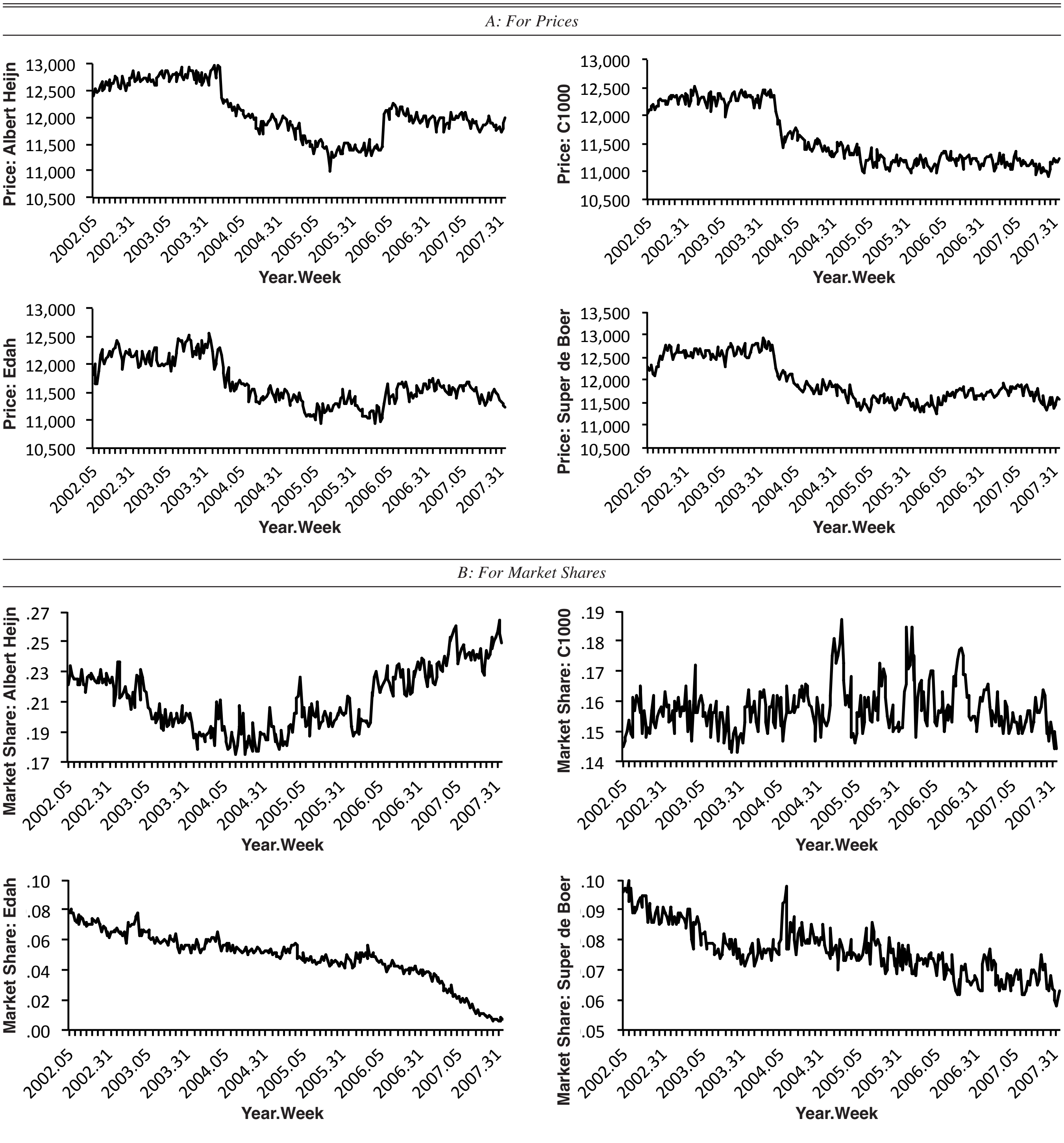
Summary

Previous price war studies have ignored the role of the media. By incorporating the media as an actor, we can unravel the impact of the firms' marketing actions from the extra effect that results from media coverage. This enhances our understanding of market response mechanisms in a price war. If we find that a firm's actions drive media coverage, which then affects consumers and investors, this means that media coverage is another communication channel for the firm, albeit one over which the firm has incomplete control.

EMPIRICAL SETTING

We study the major price war among supermarket chains in the Netherlands that took place between October 2003 and December 2005 (Van Aalst et al. 2005; Van Heerde, Gijsbrechts, and Pauwels 2008). In the years before this price war, the leading high-service, high-price chain Albert Heijn had been under increasing pressure from the hard discounters Aldi and Lidl. Offering a no-frills, very low-price strategy, these hard discounters had been stealing market share from Albert Heijn and the other traditional supermarket chains for years. The problems for Albert Heijn were compounded in early 2003, when a major accounting scandal surfaced (*The Economist* 2003). Later that year, controversy over the €10 million pay package for the chief executive officer led to an emerging consumer boycott (Rossingh 2003). On October 20, 2003 (week 43), Albert Heijn management decided to refocus attention on its prices and advertised substantial permanent price reductions for hundreds of SKUs in double-page color advertisements in all national newspapers. With the aim of becoming affordable again, the chain announced that it would cut prices until it would be on par with the average price in the market. Within a week, the other major chains responded by slashing their prices. Albert Heijn reacted, extending the range of products for which it offered permanent price cuts, to which the other chains responded again. The price war had begun, and it would rage for more than two years, until Albert Heijn decided to increase its prices substantially (see Figure 2, Panel A).

Figure 2
TIME SERIES PLOTS

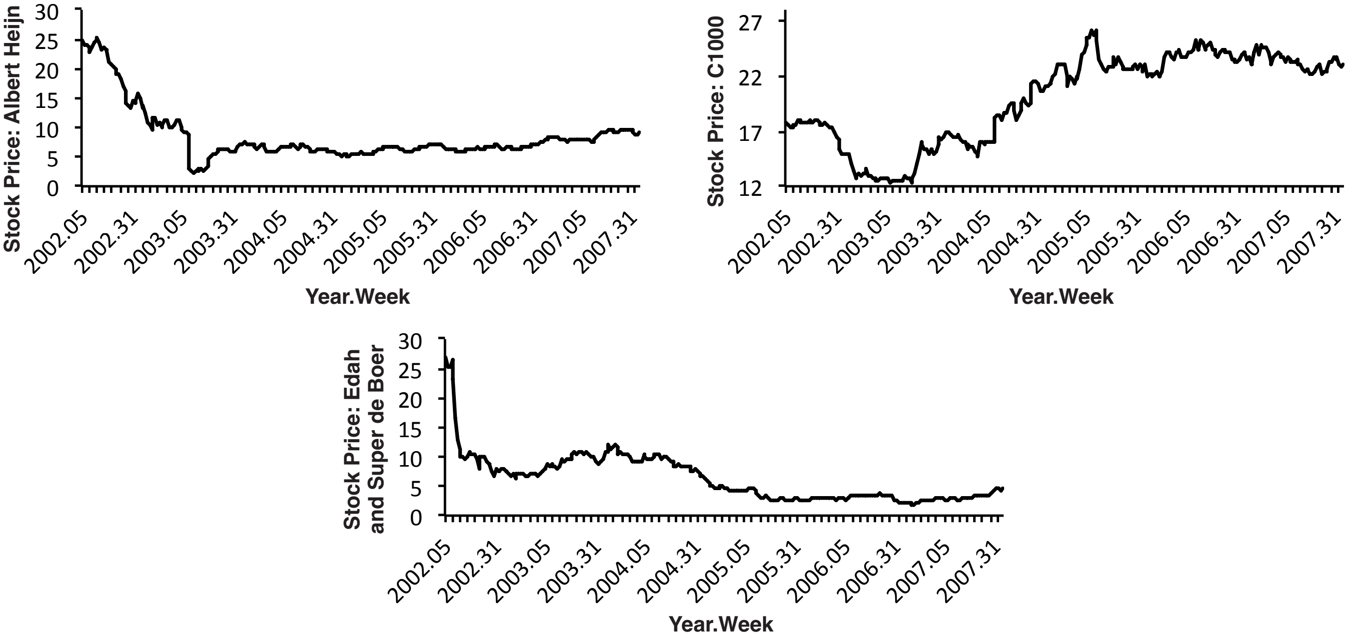


The setting clearly met the definitional conditions outlined by Heil and Helsen (2001): focus on competitors rather than consumers; strong downward, continued pressure on prices; and price competition that violated industry norms (for a more elaborate discussion, see Van Heerde, Gijsbrechts, and Pauwels 2008). The media reported on the warlike nature of the price conflict, including statements such as Albert Heijn "fights a good battle in the price war" (ANP 2003, October 27), "reconquers" 200,000 customers a week on hard discounters Aldi and Lidl (Thijssen 2004, January 10), and achieves the overall "victory" (*Het Financieele Dagblad* 2009, September 17).

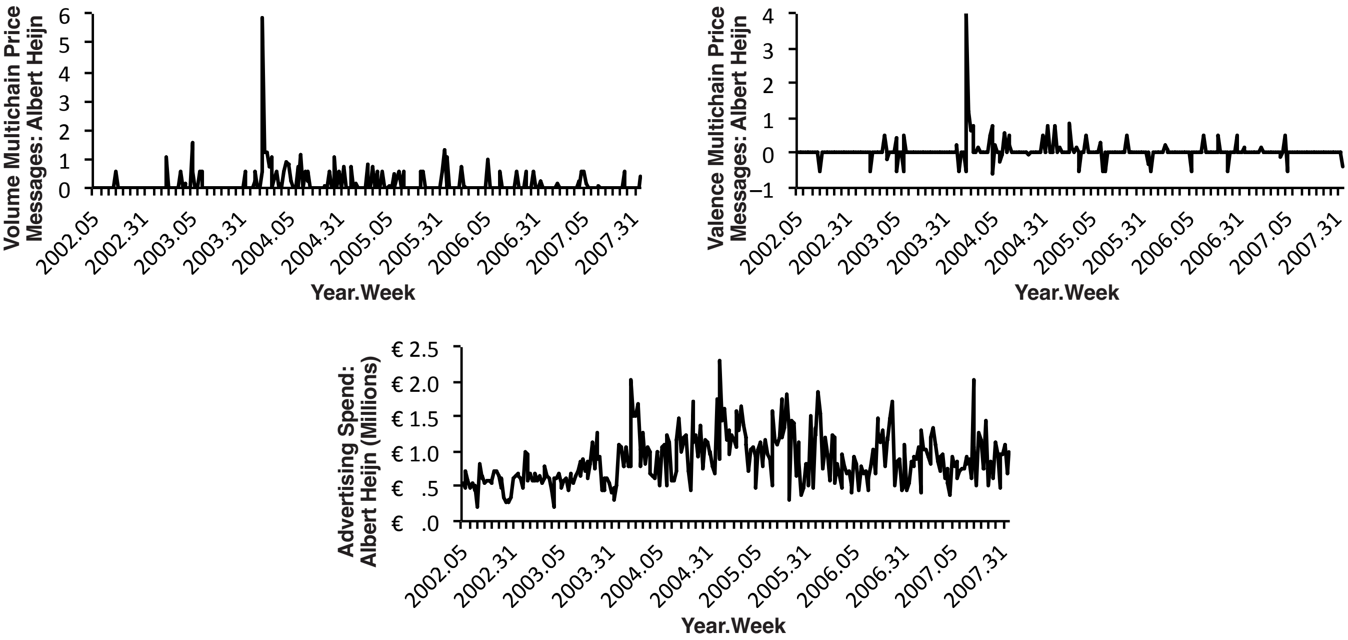
We study the four focal chains that engaged in this price war. In addition to Albert Heijn, the key adversaries were C1000 (a midprice, midservice chain), Edah (a low-price, low-service chain), and Super de Boer (a high-price, high-

Figure 2
CONTINUED

C: For Stock Prices



D: Albert Heijn Volume and Valence of Multichain Price Messages and Advertising



service chain). We have weekly data from Week 3, 2002, through Week 35, 2007. Thus, the data cover more than 1.5 years before the start of the price war through approximately one year after it ended. Because the price war was fought between retail chains, the unit of analysis is the chain. The price, market share, advertising, and press-related variables are measured at the weekly level for each of the four chains. We observe three (not four) weekly stock prices because two of the four chains are owned by the same retail holding (we provide more details subsequently). Next, we discuss the variable operationalizations. For their sources, refer to Table 1; for descriptive statistics, see Table 2 (variable correlations appear in Web Appendix A).

Chain Prices

For chain prices, the operationalization needs to meet two key challenges. First, it should allow for a clean comparison across chains. This is an important feature, given that much of the consumers' and media behavior in a price war is about price comparisons. Second, price cuts in the context of a price war do not cover the chains' offer across the board but often revolve around price changes for bestselling items (see, e.g., Van Heerde, Gijsbrechts, and Pauwels 2008). To address both challenges, we use the price of a fixed common basket of SKUs (similar to how consumer reports operationalize retail prices, and previously used by, e.g., Fox, Montgomery, and Lodish 2004). It is defined as the retailer's weekly basket price for the 100 top-selling SKUs, available at all four chains based on consumer panel data of GfK. Figure 2, Panel A, shows how the basket prices for the four chains evolved over time, and the beginning of the price war in 2003 is clearly visible.

To capture the effects of unusually deep price cuts, we examine the histogram of week-on-week price changes (Web Appendix B). Price reductions of 1.5% or more for the total basket of 100 top-selling products are quite rare: they happen in only 6.9% of the observations, the great majority of which (75%) occur after the price war had started. Because basket-wide price savings of 1.5% are quite substantial in a grocery setting, we operationalize deep price cuts as those that are 1.5% or more. We validate this threshold level in a robustness check.

Market Share

For retailer market share, we use the weekly value share among all supermarket chains within the GfK consumer panel. Figure 2, Panel B, shows how Albert Heijn's market share begins to increase significantly in the course of the price war, whereas Edah is on a downward trajectory. Indeed, Edah went bankrupt right after the observation period, which is widely attributed to the price war (e.g., http://nl.wikipedia.org/wiki/Edah).

Abnormal Stock Returns

Figure 2, Panel B, shows the evolution of the retailers' stock prices. We transform these stock prices (from Data Stream) into abnormal stock returns (see Table 1). For Albert Heijn, we use the abnormal stock returns of Ahold, the holding company, listed at the Amsterdam Stock Exchange. For C1000, we use the abnormal stock returns of its holding company, Schuitema.[2] The owner of Edah and Super de Boer is the publicly listed company Laurus, and thus we use its abnormal stock returns.[3]

Media Coverage

To capture media coverage, two experts went through all daily editions of four national Dutch newspapers (*De Telegraaf*, *De Volkskrant*, *NRC Handelsblad*, and *Het*

[2]Ahold owned part of the shares of Schuitema during part of the observation period, which may have created some correlation between their stock prices on the Amsterdam Stock exchange. Our model accounts for this correlation.

[3]We checked whether the partial sell-off of Edah in May 2006 affected Laurus's stock returns—it did not.

Table 1

VARIABLE OPERATIONALIZATIONS

Variable	*Operationalization*	*Source*
$\Delta Price_{rt}$	First difference (change from week t – 1 to week t) in log basket price for retailer r for 100 top-selling SKUs available at all four chains (in Euro cents)	GfK
$\Delta DeepPrice_{rt}$	Variable for deep price cuts equal to $\Delta Price_{rt}$ if $\Delta Price_{rt} \leq -.015$, and 0 otherwise.	GfK
$\Delta MarketShare_{rt}$	First difference (change from week t – 1 to week t) in log market share (based on revenue) for retailer r	GfK
Ad_{rt}	Log spending (€) on print and broadcast media by retailer r in week t	Nielsen Media Research
$AbStockRet_{rt}$	Abnormal stock returns. For each of the holdings (r = Laurus – Edah/SdB, Schuitema – C1000, and Ahold – Albert Heijn), stock returns ($Stock_{rt}$) are the weekly difference between the log stock prices on the Dutch stock market (AEX): $\ln(Stock\ Price_{rt}) - \ln(Stock\ Price_{rt-1})$. Abnormal stock returns are the difference between these stock returns and the risk-free returns (Rf_t): $AbStockRet_{rt} = \ln(Stock\ Price_{rt}) - \ln(Stock\ Price_{rt-1}) - Rf_t$.	Data Stream (stock prices) and Kenneth French's website (risk-free returns)
$NrMultMessages_{rt}$	Weighted number of price-related messages in four leading Dutch newspapers, involving chain r and at least one other focal chain (weight = newspaper's circulation number)	Lexis-Nexis; two independent experts
$ValMultMessages_{rt}$	Weighted number of positive messages minus number of negative multichain price messages in four leading Dutch newspapers, involving chain r and at least one other focal chain	Lexis-Nexis; two independent experts
$NrSingMessages_{rt}$	Weighted number of price-related messages in four leading Dutch newspapers, involving only chain r	Lexis-Nexis; two independent experts
$ValSingMessages_{rt}$	Weighted number of positive messages minus number of negative single-chain price messages in four leading Dutch newspapers, involving only chain r	Lexis-Nexis; two independent experts

Table 2
DESCRIPTIVE STATISTICS

	Min	*Max*	*M*	*SD*
Price				
Albert Heijn	10,993	12,964	12,093	485
C1000	10,905	12,520	11,585	508
Edah	10,938	12,561	11,660	397
Super de Boer	11,239	12,927	11,964	463
Advertising (in Thousands of Euros)				
Albert Heijn	203	2,290	870	359
C1000	75	1,906	522	352
Edah	3	897	229	180
Super de Boer	63	159	573	299
Market Share				
Albert Heijn	.18	.26	.21	.02
C1000	.14	.19	.16	.01
Edah	.01	.08	.05	.02
Super de Boer	.06	.10	.08	.01
Abnormal Stock Returns (%)				
Albert Heijn (Ahold)	–112.9	26.4	–.4	8.2
C1000 (Schuitema)	–7.6	12.1	.1	2.3
Edah and Super de Boer (Laurus)	–34.1	21.7	–.7	6.0
Number of Multichain Price Messages				
Albert Heijn	.00	5.85	1.52	.44
C1000	.00	3.18	.10	.29
Edah	.00	4.01	.07	.29
Super de Boer	.00	6.03	.09	.40
Valence of Multichain Price Messages				
Albert Heijn	–.61	4.06	.04	.32
C1000	–.54	2.64	.05	.24
Edah	–.54	2.53	.02	.20
Super de Boer	–.54	2.30	.01	.20

Notes: The statistics are reported for the original variables before taking logs and/or first differences. Sample period: Week 3, 2002 until Week 35, 2007 (N = 293 weeks). The number of messages is weighted, with newspapers' circulation numbers as weights. Descriptive statistics for single-chain messages for all chains are available from the authors on request.

Financieele Dagblad), available in Lexis-Nexis, across the five-year time span 2002–2007.[4] These newspapers cater to different audiences and, together, account for more than 62% of national press coverage, including online coverage (Cebuco 2012). The experts coded all price-related messages for each chain, newspaper, and week.[5] They marked each message as either single-chain (if only one chain is mentioned) or multichain (if the message pertains to at least two focal chains). They also coded each message as positive for the chain in question (i.e., low price), neutral, or negative (i.e., high price). Thus, each multichain message receives a (possibly different) valence score for each of the chains mentioned in the message. The initial interrater agreement on the valence (positive, neutral, or negative) of each article was 82.1%. After that, instances of interrater disagreements were discussed and resolved until there was 100% agreement. In total, our sample includes 474 message evaluations, the majority of which (359, or 76%) concern multichain messages. Importantly, price war reporting is not a zero-sum game: a positive message for one chain does not imply negative news for another. In our data, 56% of the multichain messages had the same valence (i.e., were positive, negative, or neutral) for each chain involved.

We use these evaluations to operationalize the volume and valence of media messages. Following Engelberg and Parsons (2011) and Chevalier and Mayzlin (2006), volume is the number of messages per chain and week, and message valence is the number of positive minus the number of negative messages (e.g., Chevalier and Mayzlin 2006; Onishi and Manchanda 2012). Thus, if in a given week a chain is covered in a newspaper by three positive messages, two neutral messages, and one negative message, all of which mention multiple chains, the number of multichain messages equals six and its valence equals 3 – 1 = 2. For each retailer, we first obtain these measures for each newspaper separately and then take a weighted average, using the newspapers' circulation shares as weights. We use similar calculations for the volume and valence of single-chain messages. Figure 2, Panel D, shows the evolution of the number and valence of multichain messages for Albert Heijn (other chains appear in Web Appendix C).

Advertising

Advertising data were obtained from Nielsen Media Research and cover weekly spending by each of the key

[4]One coder is a coauthor of this article; the other is a research assistant. As far as the discussion on human versus machine coding is concerned, the general tenet seems to be that careful human coding is best to pick up nuances in sentiment, and automated sentiment analysis is typically benchmarked against this gold standard of human coding/classification (e.g., Mitchell and Hitlin 2013). However, this only works when the task is manageable, which is why automated coding techniques are preferred for large applications (e.g., Tirunillai and Tellis 2012).

[5]We do not include message length as a separate variable. In the context of consumer reviews, Chevalier and Mayzlin (2006) find that after the number of messages and their content are accounted for, message length does not add explanatory power for sales.

retailers on television and print media, including store flyers. As Figure 2, Panel D, shows for Albert Heijn, advertising spending is ramped up during the price war as the firm communicates its price reductions over subsequent price war rounds. Web Appendix C shows advertising expenditure patterns for the other chains.

METHODOLOGY

Model Specification

We specify a system of equations to explore our framework. The benefit of such a simultaneous model is that it enables us to incorporate all major routes of influence between the key constructs in the model (e.g., Dekimpe and Hanssens 1995): (1) contemporaneous effects (e.g., retailer price cuts driving market share in a given week), (2) firm-specific decision rules (e.g., media incorporating the price cuts in their price war reporting), (3) competitive reactions and (4) carryover effects (e.g., retailers adjusting their prices based on competitive price moves in the same and previous weeks), (5) purchase reinforcement (e.g., previous market share shifts influencing current share), and (6) feedback effects (e.g., press messages leading to further rounds of price cuts). Modeling each of these routes contributes to our understanding of the stakeholders' interplay and the role of the media therein.

Dependent Variables

The dependent variables are price changes, market shares, abnormal stock returns, the volume and valence of multichain and single-chain press messages, and retailer advertising. Like previous research (Leeflang and Wittink 1992, 1996, 2001), we use logarithmic transformations for all variables, except press messages. Using logs renders the distribution of the variables more symmetric, facilitates the comparison of effect sizes, efficiently allows for interactions, and naturally follows from the linearization of the market share equation, as we explain next. Because message valence can take on negative as well as positive values, a log-transformation cannot be applied, so we use the untransformed variables. To keep the same (nonlog) scale as for the valence, we also use the untransformed numbers of press messages.

Unit Roots

Before setting up the equations, we test whether there are unit roots. We use the Perron (1989) test, which accommodates a possible structural break at the start of the price war (i.e., week 43 in 2003). We find unit roots in log market shares (for three of four chains), and we therefore use first differences (for consistency and ease of interpretation, we do so for all four chains).[6] For price changes, abnormal stock returns, advertising, and media variables, we find no unit roots, and thus they enter the model untransformed. No cointegration was detected.

We define the key variables in the system as follows for each retailer r in each period t (see also Table 1): $\Delta Price_{rt}$ is the first difference in the log basket price, $\Delta MarketShare_{rt}$ is the first difference in the log market share, $AbStockRet_{rt}$ is the abnormal stock return, Ad_{rt} is the log of advertising spending, $NrMultMessages_{rt}$ ($ValMultMessages_{rt}$) is the number (valence) of multichain messages about the retailer, and $NrSingMessages_{rt}$ ($ValSingMessages_{rt}$) is the number (valence) of single-chain messages about the retailer. To capture price war progression we use $CumCoverage_t$: the cumulative coverage (total number of news articles) of the price war across retailers up to week t. Deep price cuts are captured by $\Delta DeepPrice_{rt}$, which equals $\Delta Price_{rt}$ if $\Delta Price_{rt} \leq -.015$ and 0 otherwise.

Granger Causality

A premise of our conceptual framework is that retail price changes cause media coverage, which in turn causes retail price changes. Granger causality tests over lags 1 to 13 (see Trusov, Bucklin, and Pauwels 2009) indeed confirm that price changes by each of the four retail chains Granger-cause media coverage at the 5% significance level. Moreover, for each of the chains, the number of multichain messages Granger-cause own retail price changes at the 5% significance level. The same holds true for three of the four chains regarding the valence of multiple-chain messages on own retail price change. These test results, together with Granger causality on the other variables in our model, are available on request.

Dynamics

We need a consistent, logical, and identified system to study the dynamic relationships between retail prices, media coverage, market share, and stock returns, for which we use three overriding considerations. First, apart from the model for abnormal stock returns, all models include a lagged dependent variable to account for carryover effects and to test whether the independent variables have explanatory power beyond the effect of the dependent variable's past (in the spirit of Granger causality). Second, in all models, we control for a structural break due to the start of the price war, in the form of either a step dummy (when the series is in levels) or a pulse dummy (when the series is in first differences). Third, we consider the speed at which each player can react. Specifically, consumers can observe price cuts, advertising changes, and press messages in the week in which they occur and can adjust their choice of store within that week (immediate effects). The same holds for investors, who have access to price, advertising, and press information and can react (buy or sell stocks) without delay (Engelberg and Parsons 2011). Although retailers typically do not adapt prices immediately (e.g., Nijs, Srinivasan, and Pauwels 2007), competitive price cuts in a price war setting can trigger unusually quick "emergency" responses (Heil and Helsen 2001). Thus, we need to add same-week competitive actions as explanatory factors in the price and advertising models. Finally, the market share in a given week (a stock variable) is not available during that week, so this driver is included with a time lag. We also checked the number of lags required in the system. Using both Akaike's and Schwartz's information criteria, we selected one lag as optimal. We now specify the model for time period t, retailer r = 1, ..., R = 4.

[6]Note that overdifferencing is less of a problem than underdifferencing (Plosser and Schwert 1977) and that extant studies on competitive reactions also include changes in market share or sales as a focal variable (Leeflang and Wittink 1992, 1996; Steenkamp et al. 2005).

Media Messages

We expect that the retailers' price reductions, and particularly deep reductions, affect the number and valence of price-related multichain messages. We also anticipate that the effect on coverage decays as the price war progresses. We expect press coverage to be affected by the retailer's performance (i.e., its market share and stock return; e.g., Tetlock, Saar-Tsechansky, and Macskassy 2008; Xiong and Bharadwaj 2013). The extant literature has shown that media are also influenced by external factors such as paid marketing and advertising (Rinallo and Basuroy 2009; Trusov, Bucklin, and Pauwels 2009). As such, we also include the retailer's advertising spending. Finally, we use a price war step variable to accommodate a structural break in press coverage following the price war start: $PWstep_t$, which equals 0 prior to, and 1 following, the start of the price war. This leads to the models for the number and valence of price-related multichain messages:

$$(1)\ NrMultMessages_{rt} = \beta_{N0r} + \beta_{N1r}\Delta Price_{rt} + \sum_{\substack{r'=1\\ r'\neq r}}^{R} \beta_{N2rr'}\Delta Price_{r't} + \beta_{N3r}\Delta DeepPrice_{rt} + \sum_{\substack{r'=1\\ r'\neq r}}^{R} \beta_{N4rr'}\Delta DeepPrice_{r't} + \beta_{N5r}\Delta Price_{rt} \times CumCoverage_t + \beta_{N6r}Ad_{rt} + \beta_{N7r}NrMultMessages_{rt-1} + \beta_{N8r}\Delta MarketShare_{rt-1} + \beta_{N9r}Stock_{rt-1} + \beta_{N10r}PWstep_t + \varepsilon_{Nrt}, \text{ and}$$

$$(2)\ ValMultMessages_{rt} = \beta_{V0r} + \beta_{V1r}\Delta Price_{rt} + \sum_{\substack{r'=1\\ r'\neq r}}^{R} \beta_{V2rr'}\Delta Price_{r't} + \beta_{V3r}\Delta DeepPrice_{rt} + \sum_{\substack{r'=1\\ r'\neq r}}^{R} \beta_{V4rr'}\Delta DeepPrice_{r't} + \beta_{V5r}\Delta Price_{rt} \times CumCoverage_t + \beta_{V6r}Ad_{rt} + \beta_{V7r}NrMultMessages_{rt-1} + \beta_{V8r}\Delta MarketShare_{rt-1} + \beta_{V9r}Stock_{rt-1} + \beta_{V10r}PWstep_t + \varepsilon_{Vrt}.$$

We expect the same drivers (except for the cross prices) to influence the number and valence of single-chain press messages:

$$(3)\ NrSingMessages_{rt} = \beta_{C0r} + \beta_{C1r}\Delta Price_{rt} + \beta_{C2r}\Delta DeepPrice_{rt} + \beta_{C3r}\Delta Price_{rt} \times CumCoverage_t + \beta_{C4r}Ad_{rt} + \beta_{C5r}NrSingMessages_{rt-1} + \beta_{C6r}\Delta MarketShare_{rt-1} + \beta_{C7r}Stock_{rt-1} + \beta_{C8r}PWstep_t + \varepsilon_{Crt}, \text{ and}$$

$$(4)\ ValSingMessages_{rt} = \beta_{D0r} + \beta_{D1r}\Delta Price_{rt} + \beta_{D2r}\Delta DeepPrice_{rt} + \beta_{D3r}\Delta Price_{rt} \times CumCoverage_t + \beta_{D4r}Ad_{rt} + \beta_{D5r}ValSingMessages_{rt-1} + \beta_{D6r}\Delta MarketShare_{rt-1} + \beta_{D7r}Stock_{rt-1} + \beta_{D8r}PWstep_t + \varepsilon_{Drt}.$$

Retailer Decisions: Price Changes and Advertising

We expect retailers to respond to press coverage. We thus include the number and valence of media messages as our key drivers in the equation for price changes, with a moderating effect of the cumulative coverage of the price war. Because a price war setting may enhance the chains' overall pricing and advertising activity and trigger quick reactions (Heil and Helsen 2001), we accommodate a pulse dummy for the price war start and add same-week competitor instruments. Price changes and advertising decisions may be based on the chain's lagged own and competitive instruments (e.g., Nijs, Srinivasan, and Pauwels 2007) and on its previous market share. Finally, changes in firm value may feed back into marketing actions (Srinivasan and Hanssens 2009), which we capture by including lagged stock returns. Thus, we specify these models for price changes and advertising spend:

$$(5)\ \Delta Price_{rt} = \beta_{P0r} + \sum_{\substack{r'=1\\ r'\neq r}}^{R} \beta_{P1rr'}\Delta Price_{r't} + \sum_{\substack{r'=1\\ r'\neq r}}^{R} \beta_{P2rr'}\Delta DeepPrice_{r't} + \beta_{P3r}\Delta Price_{rt-1} + \sum_{\substack{r'=1\\ r'\neq r}}^{R} \beta_{P4rr'}\Delta Price_{r't-1} + \sum_{\substack{r'=1\\ r'\neq r}}^{R} \beta_{P5rr'}\Delta DeepPrice_{r't-1} + \beta_{P6r}\Delta MarketShare_{rt-1} + \beta_{P7r}Stock_{rt-1} + \beta_{P8r}NrMultMessages_{rt-1} + \beta_{P9r}ValMultMessages_{rt-1} + \beta_{P10r}NrMultMessages_{rt-1} \times CumCoverage_t + \beta_{P11r}ValMultMessages_{rt-1} \times CumCoverage_t + \beta_{P12r}NrSingMessages_{rt-1} + \beta_{P13r}ValSingMessages_{rt-1} + \beta_{P14r}PWpulse_t + \varepsilon_{Prt}, \text{ and}$$

$$(6)\quad Ad_{rt} = \beta_{A0r} + \sum_{\substack{r'=1\\ r'\neq r}}^{R} \beta_{A1rr'}Ad_{r't} + \beta_{A2r}Ad_{rt-1} + \sum_{\substack{r'=1\\ r'\neq r}}^{R} \beta_{A3rr'}Ad_{r't-1} + \beta_{A4r}\Delta MarketShare_{rt-1} + \beta_{A5r}Stock_{rt-1} + \beta_{A6r}NrMultMessages_{rt-1} + \beta_{A7r}ValMultMessages_{rt-1} + \beta_{A8r}NrSingMessages_{rt-1} + \beta_{A9r}ValSingMessages_{rt-1} + \beta_{A10r}PWstep_t + \varepsilon_{Prt}.$$

Consumer Reactions: Market Share

To ensure logical consistency for market share (ranging from 0 to 1 and summing to 1), we use an attraction equation. This model specifies a chain's market share as the ratio of its attraction divided by the attraction of all chains (i.e., our four chains of interest, plus the outside option of other supermarkets; Besanko, Gupta, and Jain 1998). A chain's attraction may be driven by (deep) price changes and advertising and by media coverage (volume and valence). The attraction model automatically accommodates synergetic effects of price, advertising, and other media (Onishi and Manchanda 2012). We linearize the model using the ratio method with $\Delta\text{MarketShare}_{0t}$ as the outside option, which is the observed (differenced) share of the chains outside the focal set of four chains. This leads to Equation 7 (see also Leeflang et al. 2000, p. 171):

$$
\begin{aligned}
(7)\quad & \Delta\text{MarketShare}_{rt} - \Delta\text{Marketshare}_{0t} = \\
& \beta_{M0r} + \beta_{M1r}\Delta\text{Price}_{rt} + \beta_{M2r}\Delta\text{DeepPrice}_{rt} + \beta_{M3r}\text{Ad}_{rt} \\
& + \beta_{M4r}\Delta\text{MarketShare}_{rt-1} + \beta_{M5r}\text{NrMultMessages}_{rt} \\
& + \beta_{M6r}\text{ValMultMessages}_{rt} + \beta_{M7r}\text{NrSingMessages}_{rt} \\
& + \beta_{M8r}\text{ValSingMessages}_{rt} + \beta_{M9r}\text{PWpulse}_{t} + \varepsilon_{Mrt}.
\end{aligned}
$$

Even though cross-marketing mix terms do not appear in the linearized form of Equation 7, because the market share model is based on a multinomial attraction specification, it automatically accommodates competitive cross-effects (refer to Web Appendix D).

Shareholder Reactions: Abnormal Stock Returns

We expect that that the number and valence of media messages affect abnormal stock returns (AbStockRet_{rt}), beyond the commonly included controls. We follow the four-factor Carhart tradition (e.g., Tirunillai and Tellis 2012), which uses the Carhart momentum factor (WML_t) plus the three Fama–French factors: (1) return of the whole stock market corrected for the risk-free return ($K_{mt} - Rf_t$), (2) small market capitalization minus big market capitalization (SMB_t), and (3) high book-to-market ratio minus low book-to-market ratio (HML_t). We operationalize these variables on the basis of the European Fama–French data available on Kenneth French's website, from which we also obtain the risk-free returns (for which we need to transform the monthly data into their weekly equivalents).

We also control for quarterly profit announcements (ΔProfit_{rt}), with ΔProfit_{rt} as the percentage change in quarterly profit compared with the previous quarter as announced in week t, if there is any announcement in week t; otherwise, it is 0.[7] Because market share increases may be a credible signal that the retailer is doing well, we also include changes in market share as a driver of stock returns. Because price and advertising expenditures may be value relevant, we add them as an explanatory variable in the stock returns equation as well (Joshi and Hanssens 2010; Tuli, Mukherjee, and Dekimpe 2012). Finally, we include the price war pulse dummy to accommodate structural level shifts and add a "Scandal" dummy in the stock-return equation for Ahold to control for the drop in its stock price at the time its accounting scandal was revealed in the press. This leads to the following specification for abnormal stock returns[8]:

$$
\begin{aligned}
(8)\quad \text{AbStockRet}_{rt} = {} & \beta_{S0r} + \beta_{S1r}(K_{mt} - Rf_t) + \beta_{S2r}\text{SMB}_t + \beta_{S3r}\text{HML}_t \\
& + \beta_{S4r}\text{WML}_t + \beta_{S5r}\Delta\text{Profit}_{rt} + \beta_{S6r}\Delta\text{Price}_{rt} \\
& + \beta_{S7r}\Delta\text{DeepPrice}_{rt} + \beta_{S8r}\text{Ad}_{rt} \\
& + \beta_{S9r}\Delta\text{MarketShare}_{rt-1} + \beta_{S10r}\text{PWpulse}_t \\
& + \beta_{S11r}\text{Scandal}_t + \beta_{S12r}\text{NrMultMessages}_{rt} \\
& + \beta_{S13r}\text{ValMultMessages}_{rt} + \beta_{S14r}\text{NrSingMessages}_{rt} \\
& + \beta_{S15r}\text{ValSingMessages}_{rt} + \varepsilon_{Srt}.
\end{aligned}
$$

Model Estimation

We allow for parameter heterogeneity across retailers, and thus the parameters have an index r (except for the scandal effect, an event specific to Albert Heijn). We accommodate intercept heterogeneity by standardizing the left- and right-hand-side variables (using chain-specific means and standard deviations) before estimation. We estimate the equations with hierarchical Bayes modeling, where we allow retailer-specific slope parameters to deviate from a common hypermean with normally distributed error terms (Chib and Greenberg 1995):

$$
(9)\qquad \beta_{Xir} = \bar{\beta}_{Xi} + u_{Xir} \text{ and } \beta_{Xirr'} = \bar{\beta}_{Xi} + u_{Xirr'},
$$

for X = N (number of multichain messages), V (valence of the multichain messages), C (number of single-chain messages), D (valence of the single-chain messages), P (price changes), A (advertising), M (market share), S (abnormal stock returns), and $i \in \{0, 1, 2, ..., 15\}$. Because we use Bayesian estimation, inferences are exact for finite samples and do not rely on asymptotics (Rossi, Allenby, and McCulloch 2005, p. 133). We allow for simultaneity by correlating the error terms across Equations 1–8. We use uninformative priors and estimate the model with the Gibbs steps outlined in Chib and Greenberg (1995), using 50,000 draws for burn-in and 50,000 draws for inferences.[9]

RESULTS

Table 3 shows the hyperparameters for Equations 1–8. They represent the mean response parameter across the retail chains, and we use them to explore our framework. To interpret the price coefficients correctly, recall that the corresponding independent variable is the change in log basket price, ΔPrice_{rt}. Thus, if this week's price is lower than last week's price, ΔPrice_{rt} is negative. If ΔPrice_{rt} has a negative response parameter, this means that the dependent variable increases when the price decreases (i.e., when the change is

[7]For Laurus, profit figures were released on a half-yearly, not quarterly, basis. We made the announcement figures comparable by using profit changes relative to the same period in the previous year.

[8]For Laurus, the holding company of both Edah and Super de Boer, we include as drivers of stock returns the press messages, prices, advertising, and market share of each of these chains.

[9]Plots of the parameters across the draws show that the model is well converged. We also ran the model for double and quadruple the number of draws and obtained practically identical results.

Table 3

MODEL ESTIMATION RESULTS (HYPERPARAMETERS)

Independent Variable	*Mdn*	*Key Findings*
Number of multichain price messages (Equation 1)		
Change in own price	–.133***	Lowering own price ($\Delta Price_{rt} < 0$) leads to more media coverage
Change in cross price	–.012	
Deep own price reduction	–.165**	Deep own price cuts ($\Delta DeepPrice_{rt} < 0$) lead to more media coverage
Deep cross price reduction	–.147***	Deep cross price cuts ($\Delta DeepPrice_{r't} < 0$) lead to more media coverage
Change in own price × Cumulative coverage	.180**	Weaker effect of own price changes on media coverage as the price war progresses
Current advertising	.033	
Lagged number of multichain price messages	.117***	
Lagged market share	.003	
Lagged stock returns	.021	
PW step dummy	.058**	Increase in media coverage when price war starts
Valence of multichain price messages (Equation 2)		
Change in own price	–.159***	Lowering own price ($\Delta Price_{rt} < 0$) leads to more favorable media coverage
Change in cross price	–.001	
Deep own price reduction	–.149***	Deep own price cuts ($\Delta DeepPrice_{r't} < 0$) lead to more favorable media coverage
Deep cross price reduction	–.164***	Deep cross price cuts ($\Delta DeepPrice_{r't} < 0$) lead to more favorable media coverage
Change in own price × Cumulative coverage	.170***	Less favorable effect of own price changes on valence of media coverage as the price war progresses
Lagged market share	–.056**	
Lagged stock returns	–.014	
Lagged valence of multichain price messages	.117***	
Current advertising	.074***	More advertising leads to more favorable media coverage
PW step dummy	.022	
Price changes (Equation 5)		
Change in cross price	.019	
Change in cross price	.019	
Deep cross price reduction	.006	
Lagged change in own price	–.214***	
Lagged change in cross price	.013	
Lagged deep cross price reduction	–.001	
Lagged market share	–.020	
Lagged stock returns	–.014	
Lagged number of multichain price messages	–.094***	More media coverage leads to lower prices
Lagged valence of multichain price messages	–.019	
Lagged number of multichain price messages × Cumulative coverage	.016	
Lagged valence of multichain price messages × Cumulative coverage	–.018	
Lagged number of single-chain price messages	–.018	
Lagged valence of single-chain price messages	.023	
PW pulse dummy	–.145***	Drop in price when price war starts (dummy becomes 1)
Market share changes (Equation 7)		
Change in current price	–.055*	A price decrease ($\Delta Price_{rt} < 0$) enhances market share
Deep price reduction	.021	
Current advertising	.173***	Advertising enhances market share
Lagged market share	–.387***	
Current number of multichain price messages	–.041	
Current valence of multichain price messages	.088**	More favorable reporting leads to higher market share
Current number of single-chain price messages	.000	
Current valence of single-chain price messages	.009	
PW pulse dummy	–.037	
Abnormal stock returns (Equation 8)		
$K_{mt} – Rf_t$ (Stock Market Return – Risk-Free Return)	.076**	
SMB (small market capitalization minus big market capitalization)	.158***	
HML (High book-to-market ratio minus low book-to-market ratio)	–.026	
WML (Carhart momentum factor)	–.121***	
ΔProfit	.040	
Change in current price	–.023	
Deep price reduction	.054*	A deep price cut ($\Delta DeepPrice_{rt} < 0$) decreases stock returns
Current advertising	.001	
Lagged market share	–.009	
PW pulse dummy	.014	
Scandal dummy (Ahold only)	–.775***	The accounting scandal leads to lower stock returns
Current number of multichain price messages	–.074**	More price-focused reporting leads to lower stock returns

Table 3
CONTINUED

Independent Variable	*Mdn*	*Key Findings*
Abnormal stock returns (Equation 8) Continued		
Current valence of multichain price messages	.050	
Current number of single-chain price messages	–.004	
Current valence of single-chain price messages	–.004	
Number of single-chain price messages (Equation 3)		
Change in current price	–.016	
Deep price reduction	–.082**	Deep price cuts ($\Delta DeepPrice_{rt} < 0$) lead to more media coverage
Change in price × Cumulative coverage	.039	
Current advertising	.030	
Lagged number of single-chain price messages	–.009	
Lagged market share	–.006	
Lagged stock returns	.003	
PW step dummy	.045*	Increase in media coverage when price war starts (dummy becomes 1)
Valence of single-chain price messages (Equation 4)		
Change in current price	–.025	
Deep price reduction	–.061	
Change in price × Cumulative coverage	.014	
Current advertising	.083***	More advertising leads to more favorable media coverage
Lagged valence of single-chain price messages	.031	
Lagged market share	–.002	
Lagged stock returns	–.019	
PW step dummy	.035	
Advertising (Equation 6)		
Current cross advertising	.066***	More cross advertising leads to more own advertising
Lagged own advertising	.555***	
Lagged cross advertising	.009	
Lagged market share	–.037	
Lagged stock returns	.014	
Lagged number of multichain price messages	.000	
Lagged valence of multichain price messages	.023	
Lagged number of single-chain price messages	.009	
Lagged valence of single-chain price messages	–.013	
PW step dummy	.064	

*Significant at the 10% level.
**Significant at the 5% level.
***Significance at the 1% level.
Notes: One-sided tests of significance based on the highest posterior density interval. PW = price war.

negative). For deep price cuts, $\Delta DeepPrice_{rt}$ assumes a negative value (equal to $\Delta Price_{rt}$); otherwise, it is zero. Thus, a negative response coefficient for $\Delta DeepPrice_{rt}$ means that a deep price cut (further) increases the dependent variable. For deep price cuts, the total effect on the dependent variable is the sum of the coefficients of the price change variable and the deep price cut variable.

The model for the number of multichain media messages has a significant negative response coefficient for own price changes ($\Delta Price_{rt}$: –.133) and for deep price cuts ($\Delta DeepPrice_{rt}$: –.165). Thus, own price cuts, and especially deep ones, increase the volume of multichain media messages about price. Likewise, message valence is affected by own price changes (–.159) and deep price cuts (–.149). Thus, the valence of multichain media messages about price is enhanced by own price cuts, in particular, deep price cuts.

The interaction of price changes with the cumulative coverage of the price war is significantly positive for both press volume (.180) and valence (.170). This means that price reductions lead to less extensive and less favorable press coverage as the price war progresses. Price changes by competing retailers do not affect the volume and valence of multichain coverage. However, deep price cuts by a competing retailer r′ (implying $\Delta DeepPrice_{r't} < 0$) do enhance the volume (–.147) and valence (–.164) of multichain messages on the focal chain (the negative coefficient times the negative value for the independent variable implies a positive effect on the dependent variable). The latter finding is in line with the observation that multichain messages often have the same valence for the chains mentioned in the message, suggesting a "glow" effect across chains.

Whereas the lagged number of media messages exerts a downward pressure on price (–.094), the lagged valence of media messages does not have a significant effect on price. Thus, more press coverage makes retailers further reduce prices, but this does not significantly depend on the tone of the coverage. Notably, we find no decay in the response of retailers to media coverage as the price war progresses.

The chain's market share is not significantly affected by the number of media messages but does increase significantly with the valence of multichain messages (.088). In other words, it is the positive tone of media messages that increases the chain's appeal to consumers, not the number of messages as such.

"Business-as-usual" price changes do not significantly affect abnormal returns. However, deep price cuts (where $\Delta DeepPrice_{rt} < 0$), which may come as an unwanted surprise to investors, have an adverse effect (.054) on stock returns because the negative independent variable is multiplied by a positive coefficient. Moreover, abnormal stock returns are significantly reduced by the number of multichain price-related media messages (–.074). These findings are in line with investors being worried when a firm is (reported to be) involved in heavy price cutting. The valence of the multichain messages does not affect abnormal stock returns significantly.

Notably, advertising enhances the valence of both multichain messages (.074) and single-chain messages (.083), suggesting that the media can be influenced to some degree by advertising (Rinallo and Basuroy 2009). As to the other variables in the models, price has the expected negative effect on own market share (–.055), while advertising spending enhances market share (.173). Single-chain press coverage has no significant effects on market share, retail prices, or abnormal stock returns, in line with the notion that these messages are perceived as driven by a single retailer's agenda and thus do not add to the effect of retailer actions (price and advertising) themselves.

Robustness Checks

We conducted four robustness checks to validate the results (which are available on request). First, we estimated a model version that allows for autocorrelated errors. The autocorrelations pick up most of the effects of the lagged dependent variables, whereas the effects for the other independent variables remain largely the same. For parsimony reasons, we retain the model without autocorrelation as the main model.

Second, as we have discussed, reporting on a price war could heighten the price sensitivity. Our model accommodates the following mechanism. In a non–price war setting, consumers (obviously) respond positively to price decreases. If these price decreases are unusually deep, as in a price war (beyond a certain threshold), the media report on the price cuts. Media coverage has an effect on consumers beyond the mere price changes themselves. Thus, the activation of the media in a price war causes the same price change to lead to a stronger total demand response than without media coverage. Thus, the indirect path of the price effect through the media accounts for the heightened price sensitivity during a price war. To test whether there are any changes in price sensitivity that are not due the media, we added the interaction between price and the price war step dummy but find that its coefficient is not significant.[10] We also tested another variant, with the interaction between multichain press messages and price in the market share equation, but again, this is not significant.

Third, we validated the threshold that defines deep price cuts as reductions of 1.5% or more in the storewide basket price. We reran all models with two alternative thresholds, 1.25% and 1.75%, with very similar results. Fourth, we also tested whether the progression of the price war makes consumers and investors less responsive to the media. In the models for market share and abnormal returns, we included the interactions between the multichain press volume and valence with the cumulative price war coverage but find that these interactions are insignificant.

Dynamic Simulations of a Price Cut

We next address the following question: How do price cuts that initiate a price war play out over time? We use dynamic simulations to track the net over-time impact of a price cut on the basis of the estimated model (e.g., Ataman, Van Heerde, and Mela 2010). Specifically, we start from a baseline scenario in which all variables assume their baseline level. Next, we use our estimated model to calculate the dynamic effect of a price cut and associated bump in advertising spending by the initiator in the first round of the price war. We do so for two scenarios. In one scenario, we allow all the routes of influence in our model to be active. In this scenario, we set the media variables at their predicted levels and calculate the total net impact. In the second scenario, we consider restricted simulations in which we shut down the impact of the media (i.e., set the coefficients of the media variables to zero while keeping the other coefficients constant). By calculating the difference between the trajectories of the full and restricted scenario, we can elucidate the role of the media in the unraveling of the price war. Pauwels (2004) and Osinga et al. (2010) also follow this full-versus-restricted approach.

Figure 3 documents the changes in retailers' prices for the 5% initial price reduction by Albert Heijn, the initiator of the price war, along with the chain's initial bump in advertising (an increase equal to 3.5 times its baseline spending). To save space, we present the figures for two chains: initiator Albert Heijn and follower Edah (similar patterns are obtained for followers C1000 and Super de Boer).

Some striking findings emerge. Albert Heijn's move sets a downward price spiral in motion. Prices become permanently lower for both players. The price changes are substantial: the first price war round resulted in a sustained (4.9%) price drop for the initiator and a sizable (2.9%) price reduction for the follower (see Figure 3, Panel A). Yet is this result due to the media?

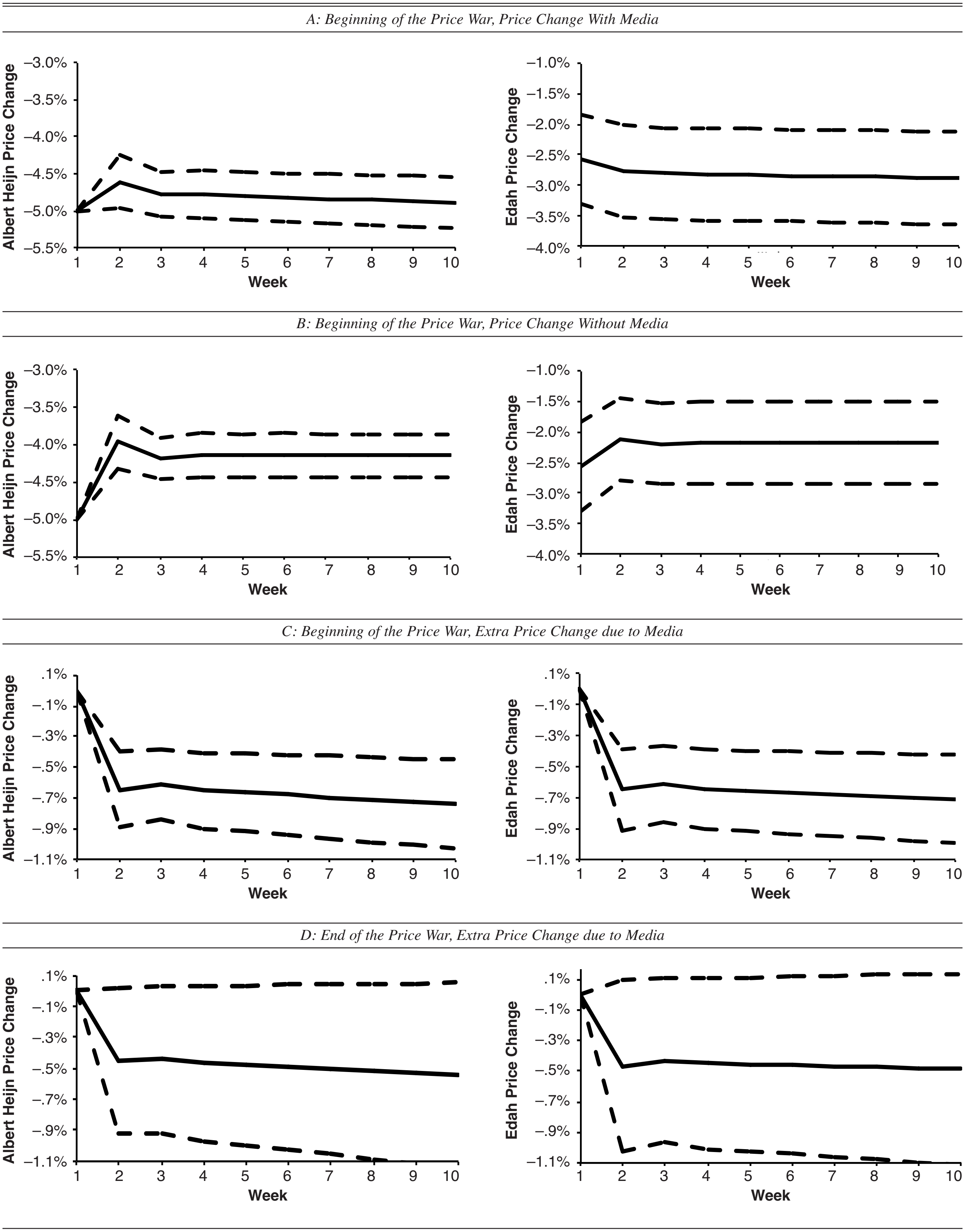
To address this question, we consider the second scenario, in which we shut down the impact of the media. Figure 3, Panel B, portrays the outcome. By calculating the difference between the outcomes of the full (Panel A) and restricted (Panel B) scenarios, we can clarify the role of the media in the first-round price war spiral (Panel C). As Panel C shows, a significant and sizable portion of the downward price spiral can be attributed to media: the media coverage leads to a .74 (vs. .71) percentage-point price decrease beyond what would be observed for Albert Heijn (vs. Edah) without coverage. Given the tight margins faced by retailers, such price reductions across the board are managerially relevant and troublesome.

How does this media influence change as the price war progresses? We simulate the effect of the same initiator price cut and advertising support but in a later price war round, at the end of the price war. This new price war round sets further price reductions in motion, some of which might again be attributed to the extra media coverage (shown in Figure 3, Panel D). Notably, a comparison with Figure 3, Panel C,

[10]Because the correlation between this price war variable and the media variables is low (i.e., average value of absolute correlations equal to .07, with all correlations well below .2), this lack of significance cannot be due to collinearity. In other words, the media variables are unlikely to pick up the change in price sensitivity that is actually due to the price war as such.

Figure 3

PRICE CHANGES FOLLOWING AN INITIAL PRICE CUT OF 5% BY ALBERT HEIJN IN WEEK 1



indicates that the media effect is now smaller in magnitude and has a wider confidence interval that includes zero. Thus, as media coverage of the price war accumulates, new price cuts generate less (positive) media attention to fuel the price spiral, and the media effect becomes insignificant.

DISCUSSION

Although there has been much speculation as to whether the media fuel wars (e.g., Galtung 2002; Lee and Maslog 2005), this study is the first endeavor to document the role of the media in a (retail) price war. We develop a framework on the antecedents and consequences of media reporting on a price war, thereby considering multiple players (i.e., retailers, consumers, press media, and investors). Specifically, we examine how the volume and valence of media coverage influence retail prices, market share, and investor returns and how this coverage channels the impact of own and competitive retail price changes over time. We explore our framework using a unique data set with weekly data covering the five years surrounding the Dutch supermarket price war of 2003–2005 and find convincing evidence for an important role of the media in a price war beyond the direct effects between the adversaries, consumers, and investors.

How Do the Media React to Price Changes?

We find that the quantity and valence of reporting is significantly driven by the price changes of the retailers. Reductions, particularly deep reductions, in regular price lead to increased favorable reporting. In addition, we find significant effects of paid advertising on the volume and valence of single-chain and multichain press messages, even after controlling for autoregressive media effects. This finding is relevant to the question of whether the media can be "manipulated" (Engelberg and Parsons 2011). Our results suggest that firms can, to some extent, stimulate coverage by the news media, a finding of great interest to managers. At the same time, this does not mean that firms are in full control of the media. Impactful media coverage of the conflict involves messages that take stock of the actions and positions of multiple chains and, as such, do not simply reiterate what is conveyed by the individual chains.

Does the Amount and Tone of Media Coverage Trigger Extra Responses from Consumers and Investors?

We find clear evidence that media coverage of the price conflict generates extra reactions from the firms' audiences, beyond those directly induced by their own price cuts or advertising. Specifically, the following novel insights emerge.

We find key differences between single- and multichain press messages. Whereas single-chain messages do not spur consumer or investor responses beyond those brought about by the firm's own actions, multichain messages *do* generate an extra influence. One explanation for this finding is that these multichain messages, unlike press reports featuring only a single chain, are considered more objective and credible sources of information (Xiong and Bharadwaj 2013). Moreover, by covering and comparing multiple parties involved in the conflict, such messages may convey new insights beyond the retailer's paid advertising or pricing.

A notable asymmetry emerges in the way retailers, consumers, and shareholders respond to price war coverage. We find that consumers only pay significant attention to messages' valence, whereas retailers and investors only respond to the volume of messages. Thus, consumers seem to carefully evaluate the content of media coverage and spend more of their grocery budget at retailers with favorable price reports in the press media.

Retailers, perhaps somewhat blinded by the fury of the price war, respond to any price war coverage by further cutting prices. As our dynamic model shows, media coverage sets in motion a spiral of yet deeper price cuts across multiple periods, thereby further intensifying the competitive price battle. This retailer response to media coverage does not abate as the price war progresses.

As for shareholders, we find that deep price cuts have a direct negative impact of abnormal stock returns. Moreover, after controlling for these price cuts, financial and performance variables, and the firm's marketing mix, we observe a significant negative impact of the quantity of press messages on abnormal stock returns. This confirms our expectation that frequent mentions in the context of a price war make investors uneasy about the firm's future cash flow prospects and drive down stock returns. The valence of the press messages does not affect abnormal stock returns significantly. A plausible explanation is that a positive valence (i.e., the chain is reported to have low prices in the media) is a double-edged sword for investors: on the one hand, this means that the chain offers a good value proposition to consumers; on the other hand, lower prices may imply lower profit margins. These opposing effects may cancel each other out, leading to an insignificant net effect on abnormal stock returns.

As such, this is the first study to document how media coverage of a price conflict (war) affects investors, beyond the direct impact of the firms' pricing actions. Our results corroborate that media coverage can severely hurt firms' stock returns (Fang and Peress 2009). We confirm that such harm exists in a price war setting but also show how it is initiated by retailer actions and driven by multichain (rather than single-chain) messages.

Taken together, our results point to the important role of the media in price war settings. Media coverage leads to a significant deepening of the price war, as indicated by the comparison of the price trajectories with and without media coverage. The key takeaway is that, for any player that considers entering a price war, it pays off to take into account the role of the media. The media can offer free publicity for the price reductions, which can further enhance market share. However, there are several caveats. First, media coverage in the context of a price war does not necessarily bode well with investors—a key concern for marketing managers and senior executives alike (Srinivasan and Hanssens 2009). Moreover, we find evidence for a self-propelling spiral, in which price cuts lead to more reporting in the media, which leads to further price cuts.

Importantly, we also document novel findings on the role of the media in the ignition and extinguishing of a price war. The spark that ignites the chain reaction of price cutting is an unusually deep price cut that is covered extensively by the media and discussed in favorable terms. This leads to a knee-jerk reaction by other retailers, and the downward price spiral is set in motion. However, as the price war progresses, media reporting on price cuts becomes less extensive and less favorable, putting a brake on the downward price spiral. This signals the beginning of the end of the price war.

In the price war that we examine, Albert Heijn had a bigger "war chest" to start with (Van Aalst et al. 2005). Edah, in contrast, was under constant and severe financial pressure, and Super de Boer was unable to follow suit in the price war and kept a rather expensive price image (Van Heerde, Gijsbrechts, and Pauwels 2008). The impact of the price war and its coverage for these frail chains has been tough, and today both chains no longer exist. From a Darwinian perspective ("survival of the fittest"), the media may have amplified the natural selection process.

Limitations and Further Research

This article has several limitations that create opportunities for follow-up research. We explore the role of the media in just one price war, and some of our results may be specific to the case we studied. We focus on the newspaper press (which is available both in print and online) because these media are most prone to systematically cover the rollout of price wars. Even so, price war reporting in broadcast media (i.e., radio and television) may exert an effect, as do messages appearing in online forums and blogs. We leave this as a topic for further study.

The valence measure focused on whether the press reported positively or negatively about the prices of specific chains. We used coding by human raters to pick up nuances in sentiment (Mitchell and Hitlin 2013). In our setting, the number of messages was not prohibitive. In addition, the majority of our messages are multichain messages, covering several chains but not necessarily with the same message valence for each chain. Distinguishing positive message valence for one chain from negative message valence for another chain in the same message is an easy task for human coders (as evidenced by the high interrater reliability) but difficult to accomplish with automated procedures. This is why we preferred to use human coding. However, this only works when the task is manageable, which is why automated coding techniques are preferred for large applications. Future studies could bring in the overall tone of the message as an additional indicator of content, for which automated approaches may offer a viable assessment method (see, e.g., Onishi and Manchanda 2012; Pauwels, Stacey, and Lackman 2013; Tirunillai and Tellis 2012).

Our model accounts for the media variables' own lagged effects and, through the error structure, for contemporaneous correlations between volume and valence. A multitude of other links could be conceived, such as the impact of message volume (valence) on valence (volume) in subsequent weeks, within and across chains, and for single- as well as multichain messages. A follow-up analysis in which we added the lagged impact of own message volume (valence) on message valence (volume) within single-chain and multichain messages showed that only one out of the four effects was significant, and the inclusion did not affect our pattern of results. Further research could focus on message variable relationships over time.

Furthermore, retailers fought in this price war by offering increasingly deep price reductions on national brands. There is no evidence to suggest that the quality of the national brands was affected (recall that we studied all press coverage across the full two years of this price war). This is different from other price war settings—for example, between airline companies for which the seller is also the producer of the service. In that case, we can expect that severe price cutting could lead to a reduction in service quality. Of course, it is of interest to document how manufacturers fare in the course of a price war between retailers, but this is outside the scope of this article. Sotgiu and Gielens (2015) investigate this manufacturer angle. In addition, because the price war mainly played out between four major retailers, we focused on them and included smaller retailers and retailers in a completely different price tier (i.e., hard discounters) as an "others" group. Likewise, the impact of media coverage on consumers' mindset metrics, or on investors' assessment of the chains' idiosyncratic risk, would be worthwhile to pursue.

In this article, we provide some initial insights into the role of the media in igniting, affecting, prolonging, and terminating price wars. In a broader sense, we believe that to understand market reactions, there are many instances beyond price wars in which it is necessary to examine not only supply (e.g., manufacturers, retailers) and demand (consumers) but also the role of the media. For example, recent research has suggested that the Irish real estate price boom and bust was at least partly driven by sensationalist reporting in the media (Mercille 2014). We hope this article stimulates new research to extend our understanding of the role of media coverage in shaping how customers, competitors, and investors react to marketing actions.

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